

**Appn No. 10/590,636**  
**Amdt date January 23, 2009**  
**Reply to Office action of October 30, 2008**

**REMARKS/ARGUMENTS**

Claims 1-23 are now in the application. Claims 2 and 14 have been amended. The Applicant respectfully requests reconsideration and allowance of the application in view of the amendment and the following remarks.

Initially, the Applicant would like to express its gratitude toward the Examiner for taking the time to discuss the present application by telephone on January 21, 2009. The amendments herein reflect the subject matter discussed by telephone with the Examiner and are believed to place the application (including its claims) in condition for allowance.

**Claim Objections**

Claim 2 is objected to because the full names of isocyanate compounds are not used, just abbreviations. Although the Applicant believes that these abbreviations are clear and does not appear to need correction, the Applicant, nevertheless, has amended Claim 2 as suggested by the Examiner to expedite allowance of the present application. In addition, similar amendment has been made to Claim 14 to expedite allowance.

**Claims Rejected Under 35 U.S.C. §103(a)**

As confirmed with the Examiner on January 21, 2009, Claims 1-7 and 13-19 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over TIEN (*Macromolecules*, 2001) in view of KAYLO (U.S. Patent No. 6,410,635) or KAYLO in view of TIEN. Claims 1-7 and 13-19 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over TIEN (*J. App. Pol. Sci.*, 2002) in view of KAYLO or KAYLO in view of TIEN. Claims 8-12, 20 and 23 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over disclosures of TIEN and KAYLO as applied to Claims 1-7 and 13-19 above and further in view of FISHBACK (U.S. Patent No. 5,798,533). Claims 21 and 22 are rejected under 35 U.S.C. §103(a) as allegedly

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being unpatentable over disclosures of TIEN and KAYLO as applied to Claims 1-7 and 13-19 above and further in view of BEALL (U.S. Patent No. 5,760,121).<sup>1</sup>

As such, in view of the foregoing, the Applicant respectfully traverse the rejections of the claims based on KAYLO and/or TIEN as follows.

The present invention in the claimed embodiment of Claim 1 provides a clay-polyurethane-nanocomposite comprising a polyurethane covalently bonded to the surface of the clay, wherein the polyurethane is formed by reacting a clay-containing diisocyanate compound with a polyol.

However, KAYLO appears to just disclose curable coating compositions composed of any of a variety of film-foaming polymers containing reactive functional group, a curing agent containing functional groups which are reactive with the functional groups of the polymer, and an exfoliated silicate material derived from a layered silicate which has been exfoliated with polymer which is compatible with both the film-forming polymer and the curing agent.

By contrast, the present invention as claimed provides a procedure for preparing polyurethane by using clay containing isocyanate as a reactive material. In the present invention as claimed, the covalent bond is formed by only this procedure.

That is, in the present invention as claimed, strong covalent bonds are formed between the clay surface and the diisocyanate compound, and the polyurethane formed by the reaction between the polyol and the diisocyanate compound based on the covalent bonds can completely exfoliate the clay layers. The clay-polyurethane nanocomposite of the present invention as claimed is characterized by the formation of covalent bonds between the remaining clay dispersed in the final nanocomposite and the polyurethane. The exfoliation of the clay layers is evident from the SEM image shown in Fig. 3 of the present application.

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<sup>1</sup> In addition, as also confirmed with the Examiner on January 21, 2009, because there is also no indication of which of the two TIEN references that the Office action intended to use to reject Claims 8-12, 20 and 23 and Claims 21 and 22, and due to the similarities between the two TIEN references, the Applicant will treat the two TIEN as being the same for the sake of the following arguments.

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KAYLO does not appear to suggest or even suggest the use of clay-containing isocyanate and the polyurethane covalently bonded to the surface of the clay in the composite. Thereby, one skilled in the art cannot conceive the polyurethane-clay composite comprising the polyurethane covalently bonded to the surface of the clay in light of the teaching KAYLO.

In addition, an embodiment of the present invention provides a method for preparing the clay-polyurethane nanocomposite comprises the steps of: (a) mixing a diisocyanate compound with a clay; (b) stirring the mixture to form covalent bonds between the diisocyanate compound and silanol groups of the clay; and (c) mixing the covalently bonded structure with a polyol and reacting the mixture with stirring.

TIEN appears only to disclose a method for preparing polyurethane comprising the steps of: melting and reacting glycol and isocyanate in DMF; adding clay in the mixture; and evaporating solvent by increasing temperature.

TIEN does not appear to disclose or even suggest that the polyurethane is covalently bonded to the surface of the clay in the composite. The TIEN process has the drawbacks that the polyurethane cannot be intercalated between the clay layers or cannot exfoliate the clay layers. That is, since the clay and polyurethane remain only in the form a mixture, no improvement in the physical properties of the polyurethane is expected.

In TIEN, as shown in its figures (in both of the TIEN references), there still are strong WAXD peaks between 2° and 10° in the nanocomposite. Therefore, one skilled in the art would not be motivated to combine KALOY with TIEN to prepare a polyurethane-diisocyanate compound modified clay nanocomposite as taught by the present invention and foresee the unexpected result in that no WAXD peak is detected between 2° and 10° by the XRD measurements.

Accordingly, there is no apparent reason why one skilled in the art would have combined the teachings of KALOY and TIEN to arrive at the claimed embodiment of Claim 1 of a "clay-polyurethane nanocomposite comprising a clay and a polyurethane covalently bonded to the surface of the clay wherein the polyurethane is formed by reacting a clay-containing diisocyanate compound with a polyol, the clay-containing diisocyanate compound contains a diisocyanate

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compound covalently bonded to surface silanol groups of the clay and 0.5~5% by weight of the clay based on the diisocyanate compound, and the clay is exfoliated by the polyurethane such that no wide-angle X-ray diffraction (WAXD) peak is detected between 2° and 10° by XRD measurement," and even if these references were to be combined, they do not teach all the claim limitations of Claim 1. Therefore, Applicant requests that the rejection of Claim 1 be withdrawn and that this claim be allowed.

Independent Claim 13 recites, a "method for preparing a clay-polyurethane nanocomposite, comprising the steps of: (a) mixing a diisocyanate compound with a clay; (b) stirring the mixture to form covalent bonds between the diisocyanate compound and silanol groups of the clay; and (c) mixing the covalently bonded structure with a polyol and reacting the mixture with stirring." As such, the Applicant submits that the claimed embodiment of Claim 13 should be allowable for at least the reasons substantially similar to the reasons given with reference to Claim 1. That is, there is no apparent reason why one skilled in the art would have combined the teachings of KAYLO and TIEN to arrive at the claimed embodiment of Claim 13 without the hindsight as taught by the present claimed embodiment, and even if these references were to be combined, they do not teach all the claim limitations of Claim 13. As such, Applicant respectfully requests that the rejection of Claim 13 be withdrawn and that these claims be allowed.

Moreover, the unexpected results of the present invention over the technical solution as disclosed in TIEN and KALO are described the present description (line 33, page 2- line 15, page 3 and line 12-35, page 5). As such, the Applicant further submit that the claimed embodiment of Claim 13 (and also the embodiment of Claim 1) of the present invention should be further allowable for effecting the unexpected results brought about by the different method for preparation from what were disclosed in TIEN and KALO.

Dependent Claims 2-12 depend (directly or indirectly) from Claim 1, and dependent Claims 14-23 depend (directly or indirectly) from Claim 13. As such, these dependent claims incorporate all the terms and limitations of their respective base claims (i.e., Claims 1 and 13) in addition to other limitations, which together further patentably distinguish them over KAYLO

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and TIEN. In addition, the addition of FISHBACK in the rejections of Claims 8-12, 20 and 23 and the addition of BEALL in the rejections of Claims 21 and 22 do not make up for the deficiencies as described above with respect to KAYLO and TIEN. In addition, the claimed embodiments of Claims 8-12, 20 and/or 23 should be further allowable because another distinctions of the present invention over the cited references is that clay-polyurethane nanocomposite of the present invention is a foam type. That is, since polyurethane foam have very different physical properties from other polyurethanes types, there is no apparent reason why one skilled in the art would have combined the teachings of KAYLO and TIEN with FISHBACK to arrive at the claimed embodiments of Claims 8-12, 20 and/or 23 without the hindsight as taught by the present claimed embodiments, and even if these references were to be combined, they do not teach all the claim limitations of these claims. As such, the Applicant respectfully submits that these dependent claims should also now be allowed.

In view of the foregoing, the Applicant respectfully submits that Claims 1-23 are in condition for allowance. Reconsideration and withdrawal of the rejection is respectfully requested, and a timely Notice of Allowability is solicited. If there are any remaining issues that can be addressed over the telephone, the Examiner is encouraged to call Applicant's attorney at the number listed below.

Respectfully submitted,  
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